

WHAT IS CLAIMED IS:

1. A flow data generation method comprising:

(a) storing, in a first storage unit, a set of binomial relation data including first term data, second term data, and relation types between the first term data and the second term data, and in a second storage unit, position data which are data on position where each value of the first term data and second term data exists in the set of binomial relation data storing in the first storage unit;

(b) extracting first binomial relation data including first term data to be a start point of flow data from the set of binomial relation data in the first storage unit;

(c) associating the start point as a first parent node with second term data of the first binomial relation data as a first child node;

(d) adding a relation type of the first binomial relation data to an arc of the first binomial relation data;

(e) searching the set of the binomial relation data in the first storage unit for third binomial relation data including first term data identical to second term data of second binomial relation data by referring to the position data in the second storage unit;

(f) associating the first term data of the third

binomial relation data as a second parent node with second term data of the third binomial relation data as a second child node;

(g) adding a relation type of the third binomial relation data to an arc of the third binomial relation data; and

(h) repeating the (e) searching, (f) associating, and (g) adding to generate a partial tree including a root identical to the second term data of the first binomial relation data.

2. A method according to claim 1, wherein the (h) repeating includes stopping the (e) searching based on the third binomial relation data when the third binomial relation data has no second term data or the third binomial relation data including the first term data identical to the second term data of the second binomial relation data has not been found.

3. A method according to claim 1, wherein the (b) extracting includes:

generating a matrix comprising a plurality of matrix elements having first matrix elements having data "0" defined by first row elements corresponding to the first term data and first column elements corresponding to the second term data, and second matrix elements having other than data "0" defined by other than the first row elements and first column elements when each row is assigned to first term data

and each column is assigned to second term data;

selecting data corresponding to one or a plurality of second row elements having a column sum "0" as one or a plurality of start point candidates;

5           selecting the start point from the start point candidates if the plurality of start point candidates exist;

determining the start point candidate as the start point if one start point candidate exist; and

10           determining the start point by a predetermined procedure if no start point candidate exists.

4. A flow data generation method comprising:

(a) storing, in a first storage unit, a set of binomial relation data including first term data, second term data, and relation types between the first term data and the second term data, and in a second storage unit, position data which are data on position where each value of the first term data and second term data exists in the set of binomial relation data  
15           storing in the first storage unit;

(b) extracting first binomial relation data including first term data to be a first start point candidate of flow data from the set of binomial relation data in the first storage unit;

25           (c) associating the first start point candidate as a first parent node with second term data of the first binomial relation data as a first child node;

(d) adding a relation type of the first binomial relation data to an arc of the first binomial relation data;

5 (e) searching the set of the binomial relation data in the first storage unit for third binomial relation data including first term data identical to second term data of the second binomial relation data by referring to the position data in the second storage unit;

10 (f) associating the first term data of the third binomial relation data as a second parent node with second term data of the third binomial relation data as a second child node;

15 (g) adding a relation type of the third binomial relation data to an arc of the third binomial relation data;

(h) repeating the (e) searching, (f) associating, and (g) adding to generate a first partial tree including a first root identical to the second term data of the first binomial relation data;

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(i) generating a first data tree including a second root identical to the first start point candidate based on the first partial tree;

(b') extracting fourth binomial relation data including first term data to be a second start point candidate of flow data from the set of binomial relation data in the first storage unit;

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(c') associating the second start point candidate as a third parent node with second term data of the fourth binomial relation data as a third child node;

5 (d') adding a relation type of the fourth binomial relation data to an arc of the fourth binomial relation data;

(h') repeating the (e) searching, (f) associating, and (g) adding to generate a second partial tree including a third root identical to the second term data of the fourth binomial relation data;

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(i') generating a second data tree including a fourth root identical to the second start point candidate based on the second partial tree;

(j) selecting one candidate from the first and second start point candidates as the start point; and

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(k) associating the start point and the defeated start point candidate, adding a relation type of binomial relation data between the start point and the defeated start point candidate to an arc between the start point and the defeated start point candidate, and integrating the first and second data trees into a third data tree.

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5. A method according to claim 1, wherein the (h) repeating includes

25 searching the set of the binomial relation data in the first storage unit for third binomial relation data including first term data of the third binomial

relation data identical to second term data of second binomial relation data by referring to the position data in the second storage unit and checking whether the third binomial relation data has been searched;

5            associating second term data of the third binomial relation data as a second child node with the first term data of the third binomial relation data as a second parent node, adding a relation type of the third binomial relation data to an arc of the third binomial  
10           relation data when the third binomial relation data has second term data which have not been searched and continuing the search;

             associating second term data of the third binomial relation data as a second child node with the first  
15           term data of the third binomial relation data as a second parent node, adding a relation type of the third binomial relation data to an arc of the third binomial relation data when the third binomial relation data has second term data which have been searched and stopping  
20           the search; and

             stopping the subsequent search when the third binomial relation data including the first term data of the third binomial relation data identical to the second term data of the second binomial relation data  
25           has not searched or the third binomial relation data has no second term data.

6. A method according to claim 1, wherein

the first term data and the second term data of the binomial relation data stored in the first storage unit have a hierarchical structure, and

the (h) repeating includes

5            searching the set of the binomial relation data in the first storage unit for third binomial relation data including first term data of the third binomial relation data identical to second term data of the second binomial relation data or belonging to the  
10          second term data of the second binomial relation data by referring to the position data in the second storage unit.

7. A method according to claim 1, wherein

the first term data and the second term data of  
15          the binomial relation data stored in the first storage unit have a hierarchical structure, and

the (h) repeating includes

searching the set of the binomial relation data in the first storage unit for third binomial relation  
20          data including first term data of the third binomial relation data identical to second term data of the second binomial relation data or belonging to the second term data of the second binomial relation data by referring to the position data in the second storage  
25          unit and checking whether the third binomial relation data has been searched.

8. A method according to claim 5, further

comprising:

selecting one node from a plurality of nodes when the plurality of nodes having same data exists;

5        redirecting the plurality of nodes other than the selected node to the selected node; and

deleting the plurality of nodes other than the selected node.

9. A method according to claim 1, further comprising:

10        generating a flow chart whose root is the first parent node by connecting the first child node to the partial tree; and

generating a work flow by selecting one node from a plurality of nodes of the flow chart when the plurality of nodes having same data exists, redirecting  
15        the plurality of nodes other than the selected node to the selected node, and deleting the plurality of nodes other than the selected node.

10. A flow data generation apparatus comprising:

20        a first unit storing, in a first storage unit, a set of binomial relation data including first term data, second term data, and relation types between the first term data and the second term data, and in a second storage unit, position data which are data on  
25        position where each value of the first term data and second term data exists in the set of binomial relation data storing in the first storage unit;



a second unit extracting first binomial relation data including first term data to be a start point of flow data from the set of binomial relation data in the first storage unit;

5           a third unit associating the start point as a first parent node with second term data of the first binomial relation data as a first child node;

10           a fourth unit adding a relation type of the first binomial relation data to an arc of the first binomial relation data;

15           a fifth unit searching the set of the binomial relation data in the first storage unit for third binomial relation data including first term data identical to second term data of second binomial relation data by referring to the position data in the second storage unit;

20           a sixth unit associating the first term data of the third binomial relation data as a second parent node with second term data of the third binomial relation data as a second child node;

a seventh unit adding a relation type of the third binomial relation data to an arc of the third binomial relation data; and

25           an eighth unit repeating the searching in the fifth unit, associating in the six unit, and adding in the seventh unit to generate a partial tree including a root identical to the second term data of the first

binomial relation data.

11. An apparatus according to claim 10, wherein  
the eighth unit stops the searching in the fifth unit  
based on the third binomial relation data when the  
5 third binomial relation data has no second term data or  
the third binomial relation data including the first  
term data identical to the second term data of the  
second binomial relation data has not been found.

12. An apparatus according to claim 10, wherein  
10 the second unit includes:

a ninth unit generating a matrix comprising  
a plurality of matrix elements having first matrix  
elements having data "0" defined by first row elements  
corresponding to the first term data and first column  
15 elements corresponding to the second term data, and  
second matrix elements having other than data "0"  
defined by other than the first row elements and first  
column elements when each row is assigned to first term  
data and each column is assigned to second term data;

20 a tenth unit selecting data corresponding to one  
or a plurality of second row elements having a column  
sum "0" as one or a plurality of start point  
candidates;

an eleventh unit selecting the start point from  
25 the start point candidates if the plurality of start  
point candidates exist; and

a twelfth unit determining the start point

candidate as the start point if one start point candidate exist or determining the start point by a predetermined procedure if no start point candidate exists.

- 5           13. A flow data generation apparatus comprising:
- a first unit storing, in a first storage unit,  
a set of binomial relation data including first term  
data, second term data, and relation types between  
the first term data and the second term data, and in  
10           a second storage unit, position data which are data on  
position where each value of the first term data and  
second term data exists in the set of binomial relation  
data storing in the first storage unit;
- a second unit extracting first binomial relation  
15           data including first term data to be a first start  
point candidate of flow data from the set of binomial  
relation data in the first storage unit;
- a third unit associating the first start point  
candidate as a first parent node with second term data  
20           of the first binomial relation data as a first child  
node;
- a fourth unit adding a relation type of the first  
binomial relation data to an arc of the first binomial  
relation data;
- 25           a fifth unit searching the set of the binomial  
relation data in the first storage unit for third  
binomial relation data including first term data

identical to second term data of the second binomial relation data by referring to the position data in the second storage unit;

5       a sixth unit associating the first term data of the third binomial relation data as a second parent node with second term data of the third binomial relation data as a second child node;

10       a seventh unit adding a relation type of the third binomial relation data to an arc of the third binomial relation data;

15       an eighth unit repeating the searching in the fifth unit, associating in the sixth unit, and adding in the seventh unit to generate a first partial tree including a first root identical to the second term data of the first binomial relation data;

      a ninth unit generating a first data tree including a second root identical to the first start point candidate based on the first partial tree;

20       a tenth unit extracting fourth binomial relation data including first term data to be a second start point candidate of flow data from the set of binomial relation data in the first storage unit;

25       an eleventh unit associating the second start point candidate as a third parent node with second term data of the fourth binomial relation data as a third child node;

      a twelfth unit adding a relation type of the

fourth binomial relation data to an arc of the fourth binomial relation data;

5 a thirteenth unit repeating the searching in the fifth unit, associating in the sixth unit, and adding in the seventh unit to generate a second partial tree including a third root identical to the second term data of the fourth binomial relation data;

10 a fourteenth unit generating a second data tree including a fourth root identical to the second start point candidate based on the second partial tree;

a fifteenth unit selecting one candidate from the first and second start point candidates as the start point; and

15 a sixteenth unit associating the start point and the defeated start point candidate, adding a relation type of binomial relation data between the start point and the defeated start point candidate to an arc between the start point and the defeated start point candidate, and integrating the first and second data trees into a third data tree.

20 14. An apparatus according to claim 10, wherein the eighth unit includes

a thirteenth unit searching the set of the binomial relation data in the first storage unit for third binomial relation data including first term data of the third binomial relation data identical to second term data of second binomial relation data by referring

to the position data in the second storage unit and checking whether the third binomial relation data has been searched;

5 a fourteenth unit associating second term data of the third binomial relation data as a second child node with the first term data of the third binomial relation data as a second parent node, adding a relation type of the third binomial relation data to an arc of the third binomial relation data when the third binomial relation data has second term data which have not been searched and continuing the search;

10 a fifteenth unit associating second term data of the third binomial relation data as a second child node with the first term data of the third binomial relation data as a second parent node, adding a relation type of the third binomial relation data to an arc of the third binomial relation data when the third binomial relation data has second term data which have been searched and stopping the search; and

15 a sixteenth unit stopping the subsequent search when the third binomial relation data including the first term data of the third binomial relation data identical to the second term data of the second binomial relation data has not searched or the third binomial relation data has no second term data.

25 15. An apparatus according to claim 10, wherein the first term data and the second term data of

the binomial relation data stored in the first storage unit have a hierarchical structure, and

the eighth unit searches the set of the binomial relation data in the first storage unit for third  
5 binomial relation data including first term data of the third binomial relation data identical to second term data of the second binomial relation data or belonging to the second term data of the second binomial relation data by referring to the position data in the second  
10 storage unit.

16. An apparatus according to claim 10, wherein  
the first term data and the second term data of the binomial relation data stored in the first storage unit have a hierarchical structure, and  
15 the eighth unit searches the set of the binomial relation data in the first storage unit for third binomial relation data including first term data of the third binomial relation data identical to second term data of the second binomial relation data or belonging  
20 to the second term data of the second binomial relation data by referring to the position data in the second storage unit and checks whether the third binomial relation data has been searched.

17. An apparatus according to claim 14, further  
25 comprising:

a seventeenth unit selecting one node from a plurality of nodes when the plurality of nodes having

same data exists;

an eighteenth unit redirecting the plurality of nodes other than the selected node to the selected node; and

5           a nineteenth unit deleting the plurality of nodes other than the selected node.

18. An apparatus according to claim 10, further comprising:

10           a twentieth unit generating a flow chart whose root is the first parent node by connecting the first child node to the partial tree; and

          a twenty-first unit generating a work flow by selecting one node from a plurality of nodes of the flow chart when the plurality of nodes having same data  
15 exists, redirecting the plurality of nodes other than the selected node to the selected node, and deleting the plurality of nodes other than the selected node.

19. A flow data generation apparatus comprising:

a processor;

20           a storage device which can be accessed by the processor;

          a first program code which is stored in the storage device and provides the processor with a command to store, in a first storage unit, a set  
25 of binomial relation data including first term data, second term data, and relation types between the first term data and the second term data, and in a second



storage unit, position data which are data on position where each value of the first term data and second term data exists in the set of binomial relation data storing in the first storage unit;

5           a second program code which is stored in the storage device and provides the processor with a command to extract first binomial relation data including first term data to be a start point of flow data from the set of binomial relation data in the  
10       first storage unit;

          a third program code which is stored in the storage device and provides the processor with a command to associate the start point as a first parent node with second term data of the first binomial  
15       relation data as a first child node;

          a fourth program code which is stored in the storage device and provides the processor with a command to add a relation type of the first binomial relation data to an arc of the first binomial relation  
20       data;

          a fifth program code which is stored in the storage device and provides the processor with a command to search the set of the binomial relation data in the first storage unit for third binomial relation  
25       data including first term data identical to second term data of second binomial relation data by referring to the position data in the second storage unit;

a sixth program code which is stored in the storage device and provides the processor with a command to associate the first term data of the third binomial relation data as a second parent node with  
5 second term data of the third binomial relation data as a second child node;

a seventh program code which is stored in the storage device and provides the processor with a command to add a relation type of the third binomial  
10 relation data to an arc of the third binomial relation data; and

an eighth program code which is stored in the storage device and provides the processor with a command to repeat the searching by the fifth program  
15 code, associating by the six program code, and adding by the seventh program code to generate a partial tree including a root identical to the second term data of the first binomial relation data.

20. A flow data generation apparatus comprising:

20 a processor;

a storage device which can be accessed by the processor;

a first program code which is stored in the storage device and provides the processor with a  
25 command to store, in a first storage unit, a set of binomial relation data including first term data, second term data, and relation types between the first

term data and the second term data, and in a second storage unit, position data which are data on position where each value of the first term data and second term data exists in the set of binomial relation data storing in the first storage unit;

5 a second program code which is stored in the storage device and provides the processor with a command to extract first binomial relation data including first term data to be a first start point candidate of flow data from the set of binomial relation data in the first storage unit;

10 a third program code which is stored in the storage device and provides the processor with a command to associate the first start point candidate as a first parent node with second term data of the first binomial relation data as a first child node;

15 a fourth program code which is stored in the storage device and provides the processor with a command to add a relation type of the first binomial relation data to an arc of the first binomial relation data;

20 a fifth program code which is stored in the storage device and provides the processor with a command to search the set of the binomial relation data in the first storage unit for third binomial relation data including first term data identical to second term data of the second binomial relation data by referring

to the position data in the second storage unit;

5       a sixth program code which is stored in the  
storage device and provides the processor with  
a command to associate the first term data of the third  
binomial relation data as a second parent node with  
second term data of the third binomial relation data as  
a second child node;

10       a seventh program code which is stored in the  
storage device and provides the processor with a  
command to add a relation type of the third binomial  
relation data to an arc of the third binomial relation  
data;

15       an eighth program code which is stored in the  
storage device and provides the processor with a  
command to repeat the searching by the fifth program  
code, associating by the sixth program code, and adding  
by the seventh program code to generate a first partial  
tree including a first root identical to the second  
term data of the first binomial relation data;

20       a ninth program code which is stored in the  
storage device and provides the processor with  
a command to generate a first data tree including  
a second root identical to the first start point  
candidate based on the first partial tree;

25       a tenth program code which is stored in the  
storage device and provides the processor with  
a command to extract fourth binomial relation data

including first term data to be a second start point candidate of flow data from the set of binomial relation data in the first storage unit;

5        an eleventh program code which is stored in the storage device and provides the processor with a command to associate the second start point candidate as a third parent node with second term data of the fourth binomial relation data as a third child node;

10       a twelfth program code which is stored in the storage device and provides the processor with a command to add a relation type of the fourth binomial relation data to an arc of the fourth binomial relation data;

15       a thirteenth program code which is stored in the storage device and provides the processor with a command to repeat the searching by the fifth program code, associating by the sixth program code, and adding by the seventh program code to generate a second partial tree including a third root identical to the second term data of the fourth binomial relation data;

20       a fourteenth program code which is stored in the storage device and provides the processor with a command to generate a second data tree including a fourth root identical to the second start point candidate based on the second partial tree;

25       a fifteenth program code which is stored in the storage device and provides the processor with

a command to select one candidate from the first and second start point candidates as the start point; and

a sixteenth program code which is stored in the storage device and provides the processor with a  
5 command to associate the start point and the defeated start point candidate, add a relation type of binomial relation data between the start point and the defeated start point candidate to an arc between the start point and the defeated start point candidate, and integrate  
10 the first and second data trees into a third data tree.

21. A flow data generation program product which causes a computer system to generate flow data, comprising:

a recording medium;  
15 a first program code which is recorded on the recording medium and provides the computer system with a command to store, in a first storage unit, a set of binomial relation data including first term data, second term data, and relation types between the first  
20 term data and the second term data, and in a second storage unit, position data which are data on position where each value of the first term data and second term data exists in the set of binomial relation data storing in the first storage unit;  
25 a second program code which is recorded on the recording medium and provides the computer system with a command to extract first binomial relation data

including first term data to be a start point of flow data from the set of binomial relation data in the first storage unit;

5       a third program code which is recorded on the recording medium and provides the computer system with a command to associate the start point as a first parent node with second term data of the first binomial relation data as a first child node;

10       a fourth program code which is recorded on the recording medium and provides the computer system with a command to add a relation type of the first binomial relation data to an arc of the first binomial relation data;

15       a fifth program code which is recorded on the recording medium and provides the computer system with a command to search the set of the binomial relation data in the first storage unit for third binomial relation data including first term data identical to second term data of second binomial relation data by referring to the position data in the second storage unit;

25       a sixth program code which is recorded on the recording medium and provides the computer system with a command to associate the first term data of the third binomial relation data as a second parent node with second term data of the third binomial relation data as a second child node;

a seventh program code which is recorded on the recording medium and provides the computer system with a command to add a relation type of the third binomial relation data to an arc of the third binomial relation data; and

an eighth program code which is recorded on the recording medium and provides the computer system with a command to repeat the searching by the fifth program code, associating by the six program code, and adding by the seventh program code to generate a partial tree including a root identical to the second term data of the first binomial relation data.

22. A flow data generation program product which causes a computer system to generate flow data, comprising:

a recording medium;

a first program code which is recorded on the recording medium and provides the computer system with a command to store, in a first storage unit, a set of binomial relation data including first term data, second term data, and relation types between the first term data and the second term data, and in a second storage unit, position data which are data on position where each value of the first term data and second term data exists in the set of binomial relation data storing in the first storage unit;

a second program code which is recorded on the



recording medium and provides the computer system with  
a command to extract first binomial relation data  
including first term data to be a first start point  
candidate of flow data from the set of binomial  
5 relation data in the first storage unit;

a third program code which is recorded on the  
recording medium and provides the computer system with  
a command to associate the first start point candidate  
as a first parent node with second term data of the  
10 first binomial relation data as a first child node;

a fourth program code which is recorded on the  
recording medium and provides the computer system with  
a command to add a relation type of the first binomial  
relation data to an arc of the first binomial relation  
15 data;

a fifth program code which is recorded on the  
recording medium and provides the computer system with  
a command to search the set of the binomial relation  
data in the first storage unit for third binomial  
20 relation data including first term data identical to  
second term data of the second binomial relation data  
by referring to the position data in the second storage  
unit;

a sixth program code which is recorded on the  
25 recording medium and provides the computer system with  
a command to associate the first term data of the third  
binomial relation data as a second parent node with

second term data of the third binomial relation data as a second child node;

5 a seventh program code which is recorded on the recording medium and provides the computer system with a command to add a relation type of the third binomial relation data to an arc of the third binomial relation data;

10 an eighth program code which is recorded on the recording medium and provides the computer system with a command to repeat the searching by the fifth program code, associating by the sixth program code, and adding by the seventh program code to generate a first partial tree including a first root identical to the second term data of the first binomial relation data;

15 a ninth program code which is recorded on the recording medium and provides the computer system with a command to generate a first data tree including a second root identical to the first start point candidate based on the first partial tree;

20 a tenth program code which is recorded on the recording medium and provides the computer system with a command to extract fourth binomial relation data including first term data to be a second start point candidate of flow data from the set of binomial relation data in the first storage unit;

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an eleventh program code which is recorded on the recording medium and provides the computer system with

a command to associate the second start point candidate as a third parent node with second term data of the fourth binomial relation data as a third child node;

5       a twelfth program code which is recorded on the recording medium and provides the computer system with a command to add a relation type of the fourth binomial relation data to an arc of the fourth binomial relation data;

10       a thirteenth program code which is recorded on the recording medium and provides the computer system with a command to repeat the searching by the fifth program code, associating by the sixth program code, and adding by the seventh program code to generate a second partial tree including a third root identical to the  
15       second term data of the fourth binomial relation data;

      a fourteenth program code which is recorded on the recording medium and provides the computer system with a command to generate a second data tree including a fourth root identical to the second start point  
20       candidate based on the second partial tree;

      a fifteenth program code which is recorded on the recording medium and provides the computer system with a command to select one candidate from the first and second start point candidates as the start point; and

25       a sixteenth program code which is recorded on the recording medium and provides the computer system with a command to associate the start point and the defeated

start point candidate, add a relation type of binomial  
relation data between the start point and the defeated  
start point candidate to an arc between the start point  
and the defeated start point candidate, and integrate  
5 the first and second data trees into a third data tree.